1. Collection of Whole Human Blood (5 Marks – 2 pages)

- **Definition:** Collection of human blood refers to the systematic withdrawal of blood from a healthy donor under sterile conditions for therapeutic use. It is the first and most critical step in blood banking.
- **Donor Selection:** Donors are screened for eligibility. Age group is usually 18–60 years, body weight above 50 kg, hemoglobin level above 12.5 g/dl. Donor should be free from infectious diseases.
- **Site & Method:** Blood is withdrawn from the **median cubital vein** in the arm. The puncture site is disinfected with **70% alcohol or povidone-iodine** to maintain asepsis.
- **Collection System:** Plastic bags containing anticoagulant-preservative solutions such as:
    - **ACD (Acid Citrate Dextrose):** Citrate prevents clotting, dextrose provides energy.
    - **CPDA-1 (Citrate Phosphate Dextrose Adenine):** Adenine helps in ATP production → longer RBC survival.
- **Volume Collected:** Usually **420–450 ml** at a time (about 8–10% of total blood volume).
- **Precautions During Collection:**
    1. Gentle mixing of blood with anticoagulant to prevent clot formation.
    2. Sterile and disposable equipment is used.
    3. Samples are simultaneously taken for **blood grouping, Rh typing, and screening for infections (HIV, HBV, HCV, syphilis, malaria)**.
- **Post-Collection:** The donor is advised to rest for 15–20 minutes, given fluids to prevent fainting.
- **Importance:** Proper collection ensures safety for both donor and recipient, reduces risk of contamination, and maintains the viability of blood components.

Storage during collection: Initially at room temperature (**22–25°C**) but must be shifted to refrigeration (**4–6°C**) within a few hours.

Donor Selection → Venipuncture → Collection in Bag with Anticoagulant → Labeling & Testing → Storage."

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2. Processing of Whole Human Blood (5 Marks – 2 pages)

- **Definition:** Processing refers to the steps by which collected whole blood is separated into different components and prepared for safe storage and use.
- **Purpose:** Since whole blood is rarely transfused, separation allows one unit to treat multiple patients (RBCs for anemia, plasma for clotting disorders, platelets for thrombocytopenia).

- **Methods of Processing:**
  - **Centrifugation:** Blood is centrifuged at controlled speeds.
    - **Low speed (soft spin):** separates plasma and red cells.
    - **High speed (hard spin):** further separates platelets from plasma.
  - **Filtration:** Removes leukocytes to prevent febrile reactions.
- **Blood Components Obtained:**
  1. **Packed Red Cells** – for anemia, trauma.
  2. **Fresh Frozen Plasma (FFP)** – contains clotting factors.
  3. **Platelet Concentrate** – for bleeding disorders.
  4. **Cryoprecipitate** – rich in factor VIII and fibrinogen.
- **Preservation Solutions:** Same as collection, ACD (21 days) or CPDA-1 (35 days).
- **Quality Control:**
  - Regular testing for sterility, hemoglobin content, hematocrit.
  - Proper labeling with blood group, Rh factor, collection date, and expiry.
- **Advantages of Processing:**
  - Reduces wastage.
  - Specific component therapy.
  - Safer and more effective transfusion.
- **Storage Area:** Refrigerators (1–6°C), plasma freezers (−20°C or below), platelet incubators (22–24°C with constant agitation).

Whole Blood → Centrifugation → RBC, Plasma, Platelets, Cryoprecipitate."

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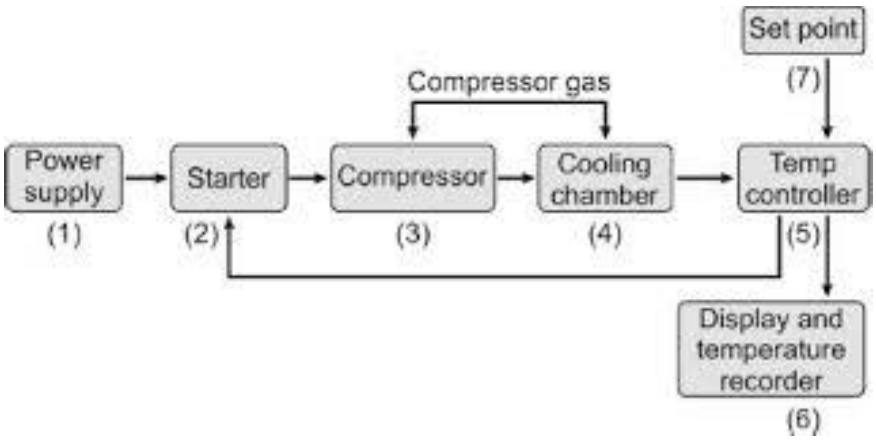
3. Storage of Whole Human Blood (5 Marks – 2 pages)

- **Principle:** Proper storage ensures blood remains viable, sterile, and safe for transfusion until its expiry date.
- **Temperature Requirements:** Blood must be stored between **2–6°C**. Higher temperatures may promote bacterial growth; freezing damages red cells.
- **Shelf Life:**
  - ACD solution → 21 days.
  - CPDA-1 solution → 35 days.
- **Blood Bank Refrigerators:**
  - Specially designed with temperature monitoring, alarms, and backup power supply.
  - Shelves for proper arrangement of bags.
- **Storage Lesions (Biochemical Changes):**
  - ↓ ATP, ↓ 2,3-DPG (affects oxygen release).
  - ↑ Potassium leakage.
  - Hemolysis risk with prolonged storage.
- **Labeling:** Each bag labeled with:
  - Donor number, blood group, Rh type.
  - Collection date, expiry date.
  - Type of anticoagulant.

- **Safety Checks:** Sterility testing, cross-matching, and visual inspection (clots, hemolysis) before transfusion.
- **Importance:** Prevents deterioration, ensures safe transfusion, reduces transfusion-transmitted infections.

Diagram: Blood bank refrigerator schematic.



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4. Dried Human Plasma (5 Marks – 2 pages)

- **Definition:** Plasma that has been separated from whole blood and then preserved by **freeze-drying (lyophilization)** to extend shelf life.
- **Preparation Process:**
  1. Whole blood collected.
  2. Plasma separated by centrifugation.
  3. Plasma frozen and subjected to vacuum drying (lyophilization).
  4. Packaged in sterile, sealed containers.
- **Properties:**
  - Retains clotting factors, proteins, antibodies.
  - Lightweight, portable, easy to store.
- **Reconstitution:** Before transfusion, sterile water is added to restore plasma to liquid form.
- **Uses:**
  - Emergency treatment of burns, hemorrhage, and shock.
  - During wars or disasters when fresh plasma is unavailable.
  - Maintains blood volume and provides clotting factors.
- **Advantages:**
  - Long shelf life (months–years).
  - Easily transported to remote areas.
- **Limitations:**
  - Lacks red cells and platelets.
  - Risk of allergic reactions.
- **Storage Condition:**
  - Dry sealed vials.

- Temperature: below 50°C.

Diagram: Flowchart: “Whole Blood → Plasma Separation → Freeze-drying → Stored Dried Plasma → Reconstitution → Use.”

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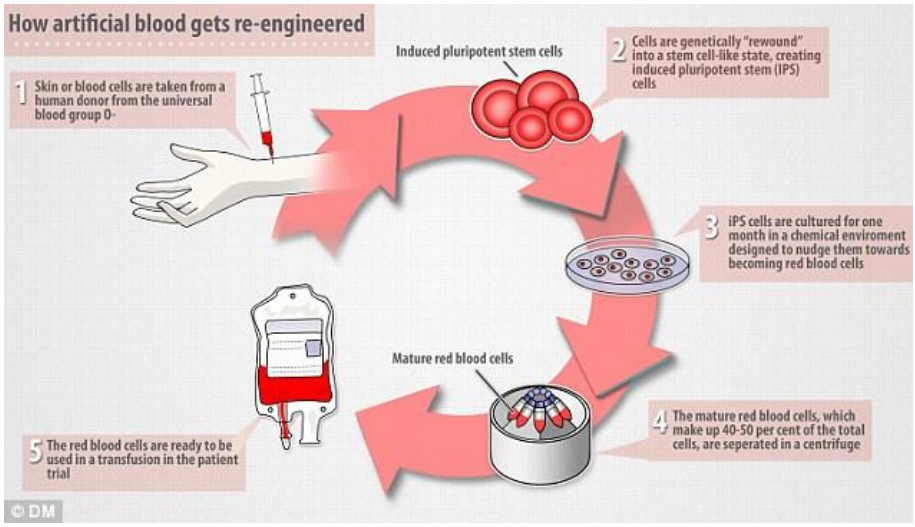
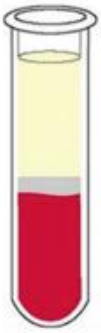
5. Plasma Substitutes (5 Marks – 2 pages)

- **Definition:** Plasma substitutes are artificial solutions that temporarily replace plasma volume in emergencies, especially during **hypovolemic shock**.
- **Characteristics:**
  - Should be sterile, pyrogen-free, and isotonic.
  - Should not disturb acid-base or electrolyte balance.
- **Common Plasma Substitutes:**
  1. **Dextran:** Polysaccharide solution; effective plasma expander; used in shock and surgery.
  2. **Gelatin (e.g., Haemaccel, Gelofusine):** Provides rapid volume expansion.
  3. **Polyvinyl Pyrrolidone (PVP):** Synthetic polymer; less commonly used now.
- **Advantages:**
  - Easily available.
  - Long shelf life.
  - No infection risk.
- **Disadvantages:**
  - No oxygen-carrying capacity.
  - May cause allergic reactions.
  - Limited duration of action.
- **Uses:**
  - Temporary replacement until blood/plasma is arranged.
  - Burns, trauma, surgical operations.
- **Storage Conditions:**
  - Store at **15–25°C** in a dry, cool area.
  - Long shelf life (months–years).

Diagram: Chart comparing “Natural Plasma vs Plasma Substitutes.”



PLASMA		SERUM	
	• anti-coagulants are needed for purification		• anti-coagulants are not needed
	• it can be prepared as soon as it has been mixed thoroughly		• 30 minutes delay for a clot formation
	• fibrinogen is present		• fibrinogen is absent
	• platelets and cells (WBCs) can contaminate the liquid fraction		• cleaner sample, depleted of cells and cell remnants, but latent clotting can lead to fibrin formation
	• composition of ions is representative of the circulating blood		• clot retraction elevates potassium level relative to its plasma value
	• considered less stable (especially during longer storage)		• considered more stable – the gold standard for biobanking